Appl. No. 09/705,572
Amdt. Dated January 13, 2004
Reply to Office action of: October 4, 2004

Listing of Claims:

This listing of claims will replace all prior versions and listing of claims in the reference application.

1. (original) A simulation system for generating a predicted performance for fabricated parts comprising:

   a rheological degradation database for storing a plurality of rheological degradation data for associated materials;

   a mechanical degradation database for storing a plurality of mechanical degradation data for associated materials;

   a computer coupled to said rheological degradation database and said mechanical degradation database for computing part performance predictions for a respective material with a predetermined geometry under predetermined processing conditions, partially based on said rheological degradation data and said mechanical degradation data.

2. (original) A simulation system in accordance with claim 1, wherein said materials are selected from the group consisting of polymer, metal and ceramic.

3. (original) A simulation system in accordance with claim 1, wherein said material is silicone.

4. (original) A simulation system in accordance with claim 1, wherein said material is magnesium.

5. (original) A simulation system in accordance with claim 1, wherein a part geometry of an object to be fabricated is imported into said computer.

6. (currently amended) A simulation system in accordance with claim 1, wherein said processing conditions include filling time, mold temperature and melt temperature.

7. (currently amended) A simulation system in accordance with claim 5, wherein said part geometry imported into said computer ~~importing a model~~ entails generating a CAD (computer aided design) part model of a three-dimensional object and discretizing the part model.

8. (cancelled)

9. (original) A simulation system in accordance with claim 7, wherein the three-dimensional model is discretized by enveloping the model with a finite element mesh.

10. (original) A simulation system in accordance with claim 9, wherein a graphics software capable of decomposing a 3-D surface into a mesh of triangular or otherwise shaped elements, or facets, is used.

11. (cancelled)

12. (original) A simulation system in accordance with claim 1, wherein a process window is generated by said computer using said mechanical degradation data and said rheological degradation data.

13. (currently amended) A simulation system in accordance with claim 12, wherein a thinwall prediction in a mold is made

14. (currently amended) A simulation system in accordance with claim 13, wherein said computer ~~16~~ compares said thin-wall prediction to said process window.

15. (currently amended) A simulation system in accordance with claim 14, wherein if the prediction falls within said process window, the simulation is complete and the fabricated part ~~part design~~ is acceptable.

16. (currently amended) A simulation system in accordance with claim 14, wherein if said prediction falls outside of said process window said fabricated part ~~part design~~ or said processing conditions are unacceptable and a modified set of inputs is presented ~~said inputs need modification~~.

17. (original) A simulation system in accordance with claim 13, wherein said thinwall prediction comprises a first filling step of size Δt_f and a temperature step of size Δt_T.

18. (currently amended) A simulation system in accordance with claim 17, wherein for conductive and convective terms, ~~said~~ a time step size, Δt, is defined as follows:

$$\Delta t \leq \frac{1}{\frac{2\alpha}{(\Delta z)^2} + \frac{v_x}{\Delta x} + \frac{v_y}{\Delta y}}$$

where

α is the thermal diffusivity

Δz is the mesh size in the thickness (or z) direction

v_x is the velocity in the x flow direction

Δx is the mesh size in the x flow direction

v_y is the velocity in the y flow direction

Δy is the mesh size in the y flow direction

~~ρ is the density~~

~~C_p is the specific heat~~

~~A, B, C are the coefficients of the Power Law viscosity model~~

~~$\dot{\gamma}$ is the shear rate and~~

~~T is the resin temperature.~~

19. (currently amended) A simulation system in accordance with claim 17, wherein for a viscous heating term, said time step is represented as follows:

$$\Delta t \leq \frac{\rho C_P}{\left| A C \dot{\gamma}^{B+2} e^{CT} \right|}$$

where,

~~α is the thermal diffusivity~~

~~Δz is the mesh size in the thickness (or z) direction~~

~~v_x is the velocity in the x flow direction~~

~~Δx is the mesh size in the x flow direction~~

~~v_y is the velocity in the y flow direction~~

~~Δy is the mesh size in the y flow direction~~

ρ is the density

C_p is the specific heat

A, B, C are the coefficients of the Power Law viscosity model

$\dot{\gamma}$ is the shear rate and

T is the resin temperature.

20. (original) A simulation system in accordance with claim 17, wherein a temperature is calculated and a pressure is calculated.

21. (original) A simulation system in accordance with claim 20, wherein a convergence of said pressure is monitored.

22. (original) A simulation system in accordance with claim 21, wherein if said pressure has converged, the system monitors for temperature convergence.

23. (original) A simulation system in accordance with claim 20, wherein a convergence of said temperature is monitored.

24. (currently amended) A simulation system in accordance with claim 23, wherein if the temperature has converged, the system monitors whether <u>a set of all temperature steps</u> ~~all of the temperature steps~~ <u>in said thinwall prediction</u> have been solved.

25. (currently amended) A simulation system in accordance with claim 24, wherein if <u>said set of</u> all ~~of the~~ temperature steps <u>in said thinwall prediction</u> have not been solved, ~~the~~ <u>a</u> next temperature step is processed.

26. (currently amended) A simulation system in accordance with claim 25, wherein if all of the temperature steps <u>in said thinwall prediction</u> have been solved, the system monitors whether ~~the~~ <u>a</u> mold has been filled.

27. (original) A simulation system in accordance with claim 26, wherein if the mold has not been filled, the next filling step is processed.

28. (currently amended) A simulation system in accordance with claim 26, wherein if the mold is full, ~~the~~ <u>a</u> ~~process continues to~~ post-processing <u>is done</u> where results are written and saved to said computer.

29. (original) A simulation system in accordance with claim 1, wherein said rheological degradation database is propagated with empirical rheological degradation data for said selected material.

30. (currently amended) A simulation system in accordance with claim 29, wherein a portion of said rheological degradation database is propagated by:

selecting a material to test;

measuring the viscosity of said selected material;

pre-shearing portions of said material at various shear rates;

measuring the viscosity of said pre-sheared material;

calculating the a viscosity ratio between said pre-sheared material and said material to detect a pre-shear effect on said material.

31. (currently amended) A simulation system in accordance with claim 29, wherein a portion of said rheological database is generated by:

selecting a material to test;

measuring the viscosity of said selected material;

heating portions of said material at various temperatures;

measuring the viscosity of said heated portions;

calculating [the] a viscosity ratio between said heated material and said material to detect a temperature effect on said material.

32. (original) A simulation system in accordance with claim 1, wherein said mechanical degradation database is propagated with empirical mechanical degradation data for said selected material.

33. (currently amended) A simulation system in accordance with claim 31, wherein a portion of said mechanical degradation database is generated by:

selecting a material to test;

computing the local shear and temperature behavior of said selected material;

selecting test conditions based on behavior information to cover a broad test range;

making sample parts under the selected test conditions;

performing impact tests on said sample parts; and

performing tensile tests on said sample parts.

34. (original) A method for generating a predicated performance for a fabricated part comprising:

importing a model;

inputting a fabrication material;

inputting processing conditions;

importing rheological degradation data for said selected material;

importing mechanical degradation data for said selected material;

generating a process window;

generating a thinwall prediction; and

comparing said thinwall prediction to said process window.

35. (original) A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing a model comprises:

generating a part model; and

discretizing said part model.

36. (original) A method for generating a predicated performance, in accordance with claim 34, wherein said step of inputting fabrication material includes:

inputting a fill time;

inputting a mold temperature; and

inputting a resin melt temperature.

37. (original) A method for generating a predicated performance, in accordance with claim 34, wherein said step of inputting a fabrication material is selected from the group consisting of polymer, metal and ceramic.

38. (currently amended) A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing rheological degradation data for said selected material comprises:

importing said ~~database~~ rheological degradation data from a rheological degradation database.

39. (currently amended) A method for generating a predicated performance, in accordance with claim 38, wherein said rheological database is generated by:

selecting a material to test;

measuring the viscosity of said selected material;

heating portions of said material at various temperatures;

measuring the viscosity of said heated portions;

calculating ~~the~~ a viscosity ratio between said heated material and said material to detect a temperature effect on said material.

40. (cancelled)

41. (original) A method for generating a predicated performance, in accordance with claim 34, wherein said step of importing mechanical degradation data for said selected material comprises:

importing said mechanical degradation data from a mechanical degradation database.

42. (original) A method for generating a predicated performance, in accordance with claim 41, wherein said mechanical database is generated by:

selecting a material to test;

computing the local shear and temperature behavior of said selected material

selecting test conditions based on behavior information to cover a broad test range;

making sample parts under the selected test conditions

performing impact tests on said sample parts; and

performing tensile tests on said sample parts.

43. (original) Computer-readable media tangibly embodying a program of instructions executable by a computer to perform a method of generating a predicated performance for a fabricated part, the method comprising:

importing a model;

inputting a fabrication material;

inputting processing conditions;

importing rheological degradation data for said selected material;

importing mechanical degradation data for said selected material;

generating a process window;

generating a thinwall prediction; and

comparing said thinwall prediction to said process window.

44. (currently amended) Computer-readable media tangibly embodying a program of instructions in accordance with claim [42] 43, wherein said media comprise at least one of a RAM, A ROM, a disk, a CDROM, a DVDROM, an ASIC and a PROM.

45. (original) A method of generating a predicated performance for a fabricated part, the method comprising:

means for importing a model;

means for inputting a fabrication material;

means for inputting processing conditions;

means for importing rheological degradation data for said selected material;

means for importing mechanical degradation data for said selected material;

means for generating a process window;

means for generating a thinwall prediction; and

means for comparing said thinwall prediction to said process window.